

REMARKS

The Official Action mailed June 5, 2002 has been received and its contents carefully noted. Filed concurrently herewith is a *Request for One Month Extension of Time*, which extends the shortened statutory period for response to October 5, 2002. Accordingly, Applicant respectfully submits that this response is being timely filed.

Applicants note with appreciation the consideration of the Information Disclosure Statements filed on October 12, 1999; May 22, 2000; September 1, 2000; November 30, 2000; January 29, 2001, April 4, 2001, August 22, 2001 and April 10, 2002. However, Applicants have not received acknowledgement of the Information Disclosure Statement filed on May 22, 2002. Applicants respectfully request the Examiner to provide an initialed copy of the Form PTO-1449 evidencing consideration of this Information Disclosure Statement. Applicants also respectfully request the Examiner to consider the Information Disclosure Statement filed on July 16, 2002.

Claims 5 and 36-60 are pending in the present application, of which claims 5, 36-48, 55 and 56 are independent. All independent claims 5, 36-48, 55 and 56 have been amended herewith and for the reasons set forth in detail below, these claims are believed to be in condition for allowance.

The Official Action objects to claims 55-60 as being substantial duplicates of claims 37, 38, 49, 50, 53 and 54, should they be found allowable. However, claims 55-60 are different from claims 37, 38, 49, 50, 53 and 54 in that independent claims 55 and 56 recite a natural oxidation film. Therefore, claims 55-60 are not duplicate claims and the Applicants respectfully request reconsideration of the objection.

The Official Action provisionally rejects claims 5 and 36-60 under the doctrine of obviousness-type double patenting based on the combination of claims 1-18 of co-pending Application Serial Number 09/894,125 and U.S. Patent 5,616,506 to Takemura. The Applicants respectfully request that the provisional rejection be held in abeyance until allowable subject matter is indicated, at which time a complete response to any remaining double patenting rejection will be made.

The Official Action rejects claims 5, 36-48, 55 and 56 as obvious based on the combination of Takemura, U.S. Patent 5,569,610 to Zhang et al. and U.S. Patent 6,071,796 to Voutsas.

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As stated in MPEP § 2143-2143.01, to establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art. "The test for an implicit showing is what the combined teachings, knowledge of one of ordinary skill in the art, and the nature of the problem to be solved as a whole would have suggested to those of ordinary skill in the art." *In re Kotzab*, 217 F.3d 1365, 1370, 55 USPQ2d 1313, 1317 (Fed. Cir. 2000). See also *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992).

With respect to independent claims 5 and 36-48, the Applicants have amended the claims to recite a feature of etching the semiconductor film into a semiconductor layer after the leveling step. In other words, the leveling step is performed before the etching step. Support for this feature is found in the specification at least on page 16, lines 11-29, and in Figs. 1C and 2A. It is respectfully submitted that the prior art, either alone or in combination, does not teach or suggest all the features of independent claims 5 and 36-48, as amended, and thus that a *prima facie* case of obviousness cannot be maintained.

The Official Action contends that Takemura discloses leveling the surface of the semiconductor film in column 7. Assuming this is true, then Takemura teaches performing the etching step after etching the semiconductor film. On the other hand, amended claims 5 and 36-48 recite that the leveling step is conducted before etching the semiconductor film as mentioned above. Further, Zhang '610 and Voutsas do not cure the deficiencies in Takemura. Reconsideration is requested.

With respect to independent claims 55 and 56, as noted above, the claims recite a natural oxidation film. The Official Action contends that Takemura discloses removing

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an oxide film 104 from a surface of the semiconductor film. It should be noted that the oxide film 104 in Takemura is not a natural oxidation film. Further, Zhang '610 and Voutsas do not cure this deficiency in Takemura. Therefore, since the prior art of record, alone or in combination, fails to disclose or suggest each and every feature of the claims, it is respectfully submitted that a *prima facie* case of obviousness cannot be maintained and favorable reconsideration is requested.

The Official Action next rejects claims 37-40, 43, 44, 46-48, 55 and 56 as obvious based on the combination Takemura, Zhang '610 and U.S. Patent 5,888,857 to Zhang. The Applicants respectfully submit that Zhang '857 also does not teach performing the leveling step before the etching step as recited in amended claims 37-40, 43, 44 and 46-48, and that Zhang '857 does not teach the natural oxidation film as recited in claims 55 and 56. Therefore, for the same reasons as noted above, it is submitted that a *prima facie* case of obviousness cannot be maintained and favorable reconsideration is requested.

The Official Action next rejects claims 41-45 as obvious based on the combination of Takemura, Zhang '610, Zhang '857 and U.S. Patent 6,285,042 B1 to Ohtani et al. The Applicants again respectfully submit that Ohtani also does not teach performing the leveling step before the etching step as recited in claims 41-45 and that a *prima facie* case of obviousness cannot be maintained. Favorable reconsideration is requested.


Should the Examiner believe that anything further would be desirable to place this application in better condition for allowance, the Examiner is invited to contact Applicant's undersigned attorney at the telephone number listed below.

Respectfully submitted,



Eric J. Robinson
Reg. No. 38,285

Robinson Intellectual Property Law Office, P.C.
PMB 955
21010 Southbank Street
Potomac Falls, Virginia 20165
(571) 434-6789



VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Please amend claims 5, 36-48 and 56 as follows:

5. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film comprising silicon over a substrate;

providing said semiconductor film with a catalytic element for facilitating a crystallization of said semiconductor film;

irradiating said semiconductor film with laser light in air for crystallizing said semiconductor film after providing said catalytic element;

removing an oxide film from a surface of said semiconductor film by etching after said irradiation of said laser light; [and]

leveling said surface of said semiconductor film by heating after removing said oxide film; and

etching said semiconductor film into a semiconductor layer after said leveling step.

36. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film comprising silicon over a substrate;

providing said semiconductor film with a catalytic element for facilitating a crystallization of said semiconductor film;

irradiating said semiconductor film with laser light in air for crystallizing said semiconductor film after providing said catalytic element;

removing an oxide film from a surface of said semiconductor film by etching after said irradiation of said laser light; [and]

leveling said surface of said semiconductor film by heating in a reducing atmosphere after removing said oxide film; and

etching said semiconductor film into a semiconductor layer after said leveling step.

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37. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film comprising silicon over a substrate;

providing said semiconductor film with a catalytic element for facilitating a crystallization of said semiconductor film;

irradiating said semiconductor film with laser light in air for crystallizing said semiconductor film after providing said catalytic element;

removing an oxide film from a surface of said semiconductor film by etching after said irradiation of said laser light; [and]

leveling said surface of said semiconductor film by heating in an inert gas after removing said oxide film; and

etching said semiconductor film into a semiconductor layer after said leveling step.

38. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film comprising silicon over a substrate;

providing said semiconductor film with a catalytic element for facilitating a crystallization of said semiconductor film;

irradiating said semiconductor film with laser light in air for crystallizing said semiconductor film after providing said catalytic element;

removing an oxide film from a surface of said semiconductor film by etching after said irradiation of said laser light; [and]

leveling said surface of said semiconductor film by heating in an atmosphere after removing said oxide film, wherein a concentration of oxygen or [a] an oxygen compound contained in said atmosphere is 10 ppm or less; and

etching said semiconductor film into a semiconductor layer after said leveling step.

39. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

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forming a semiconductor film comprising silicon over a substrate;
providing said semiconductor film with a catalytic element for facilitating a crystallization of said semiconductor film;
irradiating said semiconductor film with laser light in air for crystallizing said semiconductor film after providing said catalytic element;
removing an oxide film from a surface of said semiconductor film by etching after said irradiation of said laser light; [and]
leveling said surface of said semiconductor film by heating in a reducing atmosphere after removing said oxide film, wherein a concentration of oxygen or [a] an oxygen compound contained in said reducing atmosphere is 10 ppm or less; and
etching said semiconductor film into a semiconductor layer after said leveling step.

40. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film comprising silicon over a substrate;
providing said semiconductor film with a catalytic element for facilitating a crystallization of said semiconductor film;
irradiating said semiconductor film with laser light in air for crystallizing said semiconductor film after providing said catalytic element;
removing an oxide film from a surface of said semiconductor film by etching after said irradiation of said laser light; [and]
leveling said surface of said semiconductor film by heating in an inert gas after removing said oxide film, wherein a concentration of oxygen or [a] an oxygen compound contained in said inert gas is 10 ppm or less; and
etching said semiconductor film into a semiconductor layer after said leveling step.

41. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film comprising silicon over a substrate;

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providing said semiconductor film with a catalytic element for facilitating a crystallization of said semiconductor film;

irradiating said semiconductor film with laser light in air for crystallizing said semiconductor film after providing said catalytic element;

treating a surface of said semiconductor film with a hydrofluoric acid after said irradiation of said laser light; [and]

leveling said surface of said semiconductor film by heating after said treatment with said hydrofluoric acid; and

etching said semiconductor film into a semiconductor layer after said leveling step.

42. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film comprising silicon over a substrate;

providing said semiconductor film with a catalytic element for facilitating a crystallization of said semiconductor film;

irradiating said semiconductor film with laser light in air for crystallizing said semiconductor film after providing said catalytic element;

treating a surface of said semiconductor film with a hydrofluoric acid after said irradiation of said laser light; [and]

leveling said surface of said semiconductor film by heating after said treatment with said hydrofluoric acid in a reducing atmosphere; and

etching said semiconductor film into a semiconductor layer after said leveling step.

43. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film comprising silicon over a substrate;

providing said semiconductor film with a catalytic element for facilitating a crystallization of said semiconductor film;

irradiating said semiconductor film with laser light in air for crystallizing said semiconductor film after providing said catalytic element;

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treating a surface of said semiconductor film with a hydrofluoric acid after said irradiation of said laser light; [and]

leveling said surface of said semiconductor film by heating after said treatment with said hydrofluoric acid in an inert gas; and

etching said semiconductor film into a semiconductor layer after said leveling step.

44. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film comprising silicon over a substrate;

providing said semiconductor film with a catalytic element for facilitating a crystallization of said semiconductor film;

irradiating said semiconductor film with laser light in air for crystallizing said semiconductor film after providing said catalytic element;

treating a surface of said semiconductor film with a hydrofluoric acid after said irradiation of said laser light; [and]

leveling said surface of said semiconductor film by heating after said treatment with said hydrofluoric acid in an atmosphere, wherein a concentration of oxygen or [a] an oxygen compound contained in said atmosphere is 10 ppm or less; and

etching said semiconductor film into a semiconductor layer after said leveling step.

45. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film comprising silicon over a substrate;

providing said semiconductor film with a catalytic element for facilitating a crystallization of said semiconductor film;

irradiating said semiconductor film with laser light in air for crystallizing said semiconductor film after providing said catalytic element;

treating a surface of said semiconductor film with a hydrofluoric acid after said irradiation of said laser light; [and]

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leveling said surface of said semiconductor film by heating after said treatment with said hydrofluoric acid in a reducing atmosphere, wherein a concentration of oxygen or [a] an oxygen compound contained in said reducing atmosphere is 10 ppm or less; and

etching said semiconductor film into a semiconductor layer after said leveling step.

46. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film comprising silicon over a substrate;

providing said semiconductor film with a catalytic element for facilitating a crystallization of said semiconductor film;

irradiating said semiconductor film with laser light in air for crystallizing said semiconductor film after providing said catalytic element;

treating a surface of said semiconductor film with a hydrofluoric acid after said irradiation of said laser light; [and]

leveling said surface of said semiconductor film by heating after said treatment with said hydrofluoric acid in an inert gas, wherein a concentration of oxygen or [a] an oxygen compound contained in said inert gas is 10 ppm or less; and

etching said semiconductor film into a semiconductor layer after said leveling step.

47. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film comprising silicon over a substrate;

providing said semiconductor film with a catalytic element for facilitating a crystallization of said semiconductor film;

irradiating said semiconductor film with laser light in an atmosphere containing oxygen for crystallizing said semiconductor film after providing said catalytic element;

removing an oxide film from a surface of said semiconductor film by etching after said irradiation of said laser light; and

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leveling said surface of said semiconductor film by heating in an atmosphere after removing said oxide film, wherein a concentration of oxygen or [a] an oxygen compound contained in said atmosphere is 10 ppm or less; and

etching said semiconductor film into a semiconductor layer after said

• leveling step.

48. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film comprising silicon over a substrate;

providing said semiconductor film with a catalytic element for facilitating a crystallization of said semiconductor film;

irradiating said semiconductor film with laser light in an atmosphere containing oxygen for crystallizing said semiconductor film after providing said catalytic element;

treating a surface of said semiconductor film with a hydrofluoric acid after said irradiation of said laser light; [and]

leveling said surface of said semiconductor film by heating after said treatment with said hydrofluoric acid in an atmosphere, wherein a concentration of oxygen or [a] an oxygen compound contained in said atmosphere is 10 ppm or less; and

etching said semiconductor film into a semiconductor layer after said leveling step.

56. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film comprising silicon over a substrate;

providing said semiconductor film with a catalytic element for facilitating a crystallization of said semiconductor film;

irradiating said semiconductor film with laser light in air for crystallizing said semiconductor film after providing said catalytic element;

removing a natural oxidation film from a surface of said semiconductor film by etching; and

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leveling said surface of said semiconductor film by heating in an atmosphere after removing said natural oxidation film, wherein a concentration of oxygen or [a] an oxygen compound contained in said atmosphere is 10 ppm or less.

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